Cold Climate Housing Research Center

CCHRC

# Hybrid Micro Energy Program
## Award No. 01163
### Quarterly Report: April 1, 2011 to June 30, 2011

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CCHRC and the Denali Commission amended the grant during the 2nd quarter of 2011 to enhance grant deliverables. To accomplish this, the amendment extends the grant period in order to lengthen the monitoring period for the ground source heat pump project; an action based on a recent report calling for long-term research of in situ ground source heat pumps in cold climates. Although the grant period is extended, CCHRC will maintain its original deliverable schedule for the small scale combined heat and power research, and the solar PV and wind project research.

Project progress is described in more detail below.

## A small scale biomass combined heat and power (CHP) system that can convert wood into heat and power for use in small scale loads including residences, small community facilities, and potentially small communities and/or neighborhoods.

CCHRC has used a variety of methods over several years to search for, identify, and procure a small-scale biomass CHP unit that shows promise of meeting the practical and economic demands in Alaska. While CCHRC remains hopeful that a promising small-scale biomass CHP unit will emerge that merits testing and application, CCHRC is going to focus its efforts in this area of the grant award on preparing a report documenting our findings and experience related to the small-scale biomass CHP industry.

## A ground source heat pump project that includes solar thermal collection to recharge the ground

During the 2nd quarter of 2011 CCHRC and the Fairbanks North Star Borough School District finished installation and commissioning of the hybrid heat pump system. The glycol mixture was added to the system in early June and the entire system was tested. All of the components are working properly and are ready for the start of the heating season. The solar system was also checked to make sure it is functioning. The school district will be draining the solar system in July so that we can get one year of data without the solar recharge to the ground.

The data collection system is collecting data. CCHRC will finish testing that system in the 3rd quarter. Data will be live on an informational website about the Weller project around the time school starts in August.

## A combined solar photovoltaic (PV) and wind system integrated into an energy efficient load design.

The Denali Commission funding is being utilized to monitor and report the performance of a combined solar photovoltaic (PV) and wind system (Figure 2) installed at the Anaktuvuk Pass house (A Sustainable Northern Communities prototype house). The power systems were funded by the Yukon River Inter-Tribal Watershed Council (YRITWC), who is also a partner in the overall evaluation of the alternative energy systems. GW Scientific and Campbell Scientific are providing In-Kind matching support. CCHRC, YRITWC and GW Scientific comprise the main technical interpretative team. Remote Power Inc. has been providing valuable In-Kind matching technical support related to the wind and solar power systems.

2011 second quarter activities included a May 2011 site visit to replace a data logger on the monitoring system. The solar system started providing measurable power back to the residence in February. Figure 3 shows the location of Anaktuvuk Pass in a high mountain pass in the Brooks Range. The local weather patterns, mountainous terrain effects and seasonal effects of land-surface snow cover are important in evaluating the applications of solar power. Part of the design goals were to build to the environment in regards to solar exposure and winter snow cover. Figure 2 shows panels in their adjusted vertical orientation. This orientation not only helps shed snow cover, but also allows the reflect solar radiation from the snow pack in front of the house to have more direct exposure on the solar panels. The panels were left in this position for the summer 2011 season to look at the differences in performance.

The hybrid power system is helping reduce the demand on the electrical usage from the village utility grid and continues to serve as an active example of solar power for the community residents and other villages in the North Slope Borough. Figure 4 shows some of the data from the solar system and the impacts of winter and solar conditions on solar panel power generation during the 2010/2011 winter season. Data collection from the Fronius inverter was started during late April 2010. The final project report will discuss the factors impacting solar power generation in Anaktuvuk Pass and lessons learned. The combination of renewable energy systems and energy efficiency at the Anaktuvuk Pass prototype home is serving as an active demonstration of possibilities in sustainable northern communities, while simultaneously serving as a valuable research platform to help determine not only how the technology works, but what training and background residents need to help maintain alternative energy solutions installed at the homeowner level. Results of the Denali Commission supported HMEP projects will become available on CCHRC's website.

Figure 2. The solar system has had the panel adjusted to be as vertical as possible with the mounting brackets and snow/ice removed. This orientation has resulted in snow-free conditions in the during spring conditions. (Photograph by M. Lilly, April 20, 2011).

Figure 3. Anaktuvuk Pass is a roadless community located in a high mountain pass in the middle of the Brooks Range. Even in the setting, solar energy can be used to offset high energy costs associated with diesel fuel that must be flown in to help support electrical power generation. Design considerations need to take into account regional weather conditions, sun shading due to mountainous terrain, and increased efficiency due to prolonged snow conditions in the fall and spring (photograph by M. Lilly, July 20, 2011)

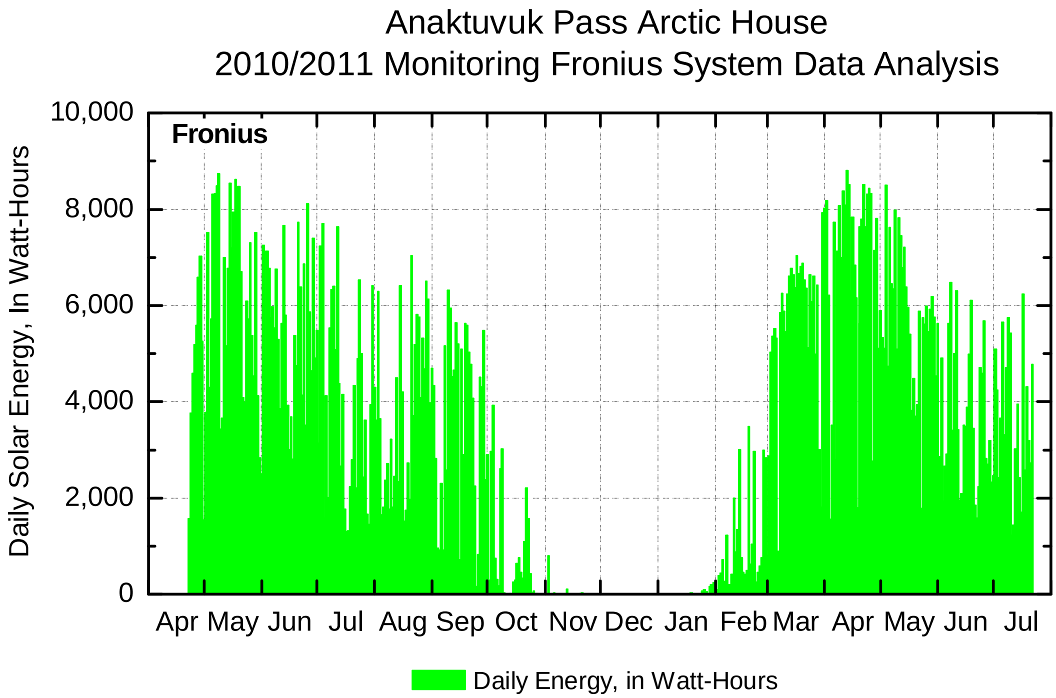


Figure 4. Solar panel output measured by the Fronius inverter. There is approximately a 2 month period in the middle of winter with no solar input. Solar charging during March, April, and part of May will be impacted additional reflection off of the snow-covered ground in front of the panels.